

B I

(12) UK Patent Application (19) GB (11) 2 068 586 A

(21) Application No 8001488
(22) Date of filing 16 Jan 1980
(43) Application published
12 Aug 1981

(51) INT CL³
G03C 5/26

(52) Domestic classification
G2X S3
B8R 414 471 475 491
652 664 723 AA6

(56) Documents cited
GB 1536198
GB 1293013

(58) Field of search
B8R
G2X

(71) Applicant
Cesare Azzaroni,
Via Toscana, 51, Bologna,
Italy

(72) Inventor
Cesare Azzaroni

(74) Agent
Marks & Clerk,
Scottish Life House,
Bridge Street, Manchester
M3 3DP

(54) Automatic Machine for Loading and Unloading Films in Radiography Cassettes

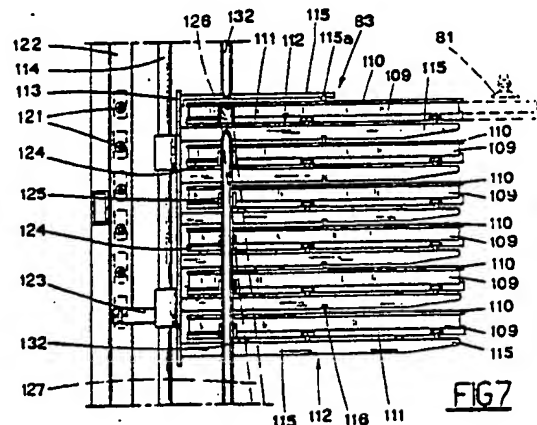
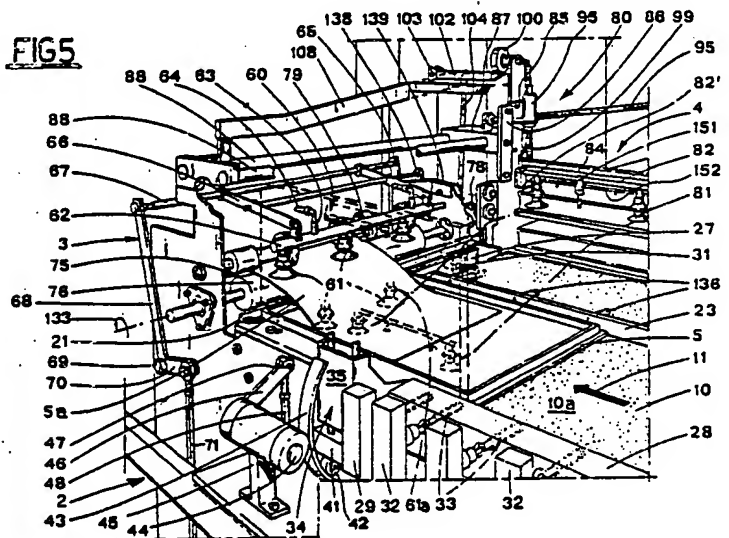
(57) After a cassette is opened and the exposed film removed, it is reloaded with film of the appropriate format selected from a magazine (83) containing different format films. The magazine is movable to position the selected film adjacent a film withdrawing and transfer device.

The magazine comprises various cassettes (109) at different levels, supported by a plate (113), sliding on

vertical guides and equipped with a stylus (123), which operates, in succession, a series of level signalling microswitches (121). The format of the inserted cassette (5) is detected by devices (31) and (32), and the microswitches operate to position the cassette (109) containing the film (137) of relevant format adjacent to a drive device (80—81) which transfers the film into the open cassette (5).

Means (34) and (36) open the cover (5c) of the cassette and means (136) detach any film (5a) which may have remained attached to the cover (5c).

FIG5



The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

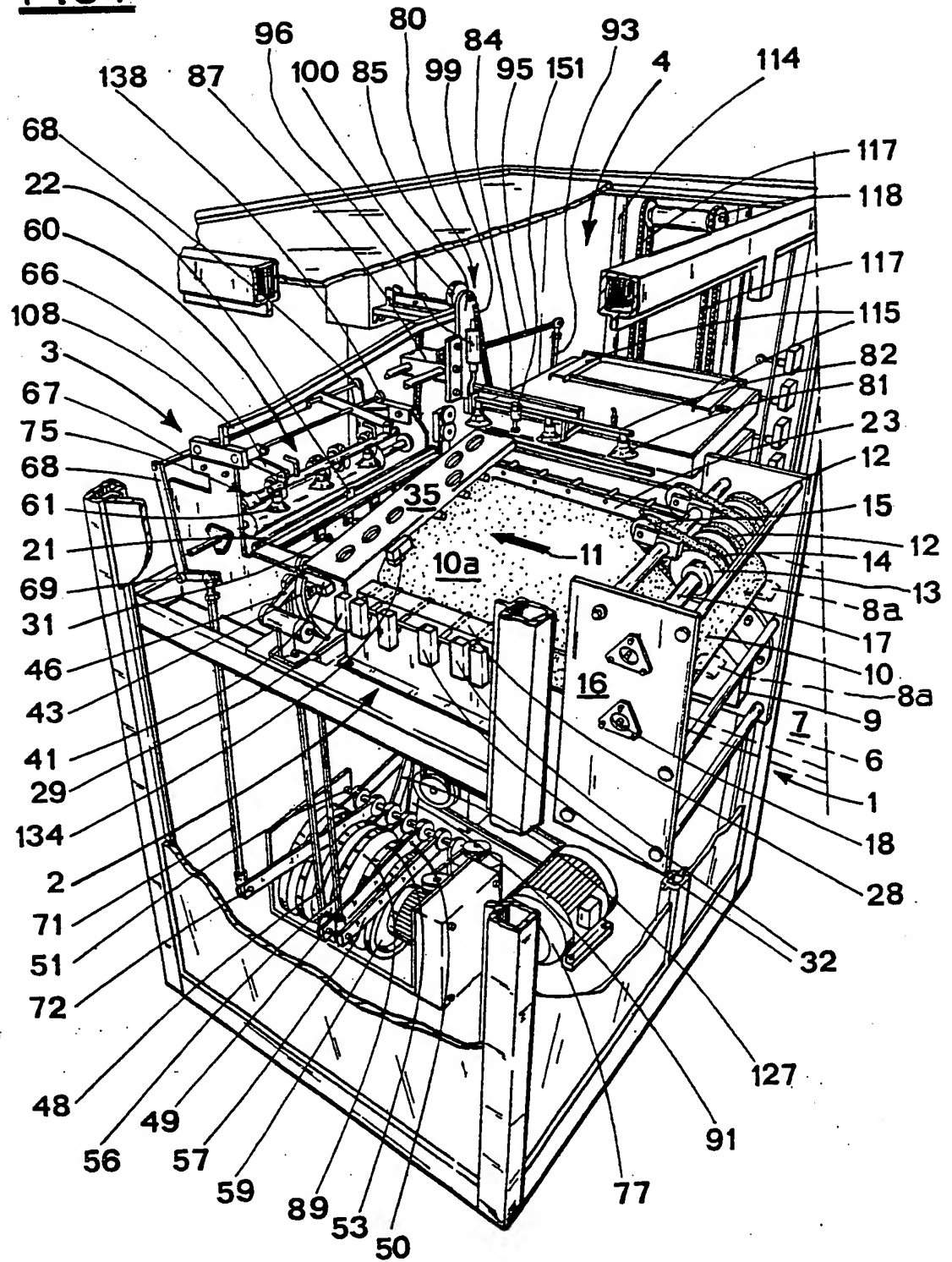
A 013666

GB 2 068 586 A

2068586

1/7

FIG1



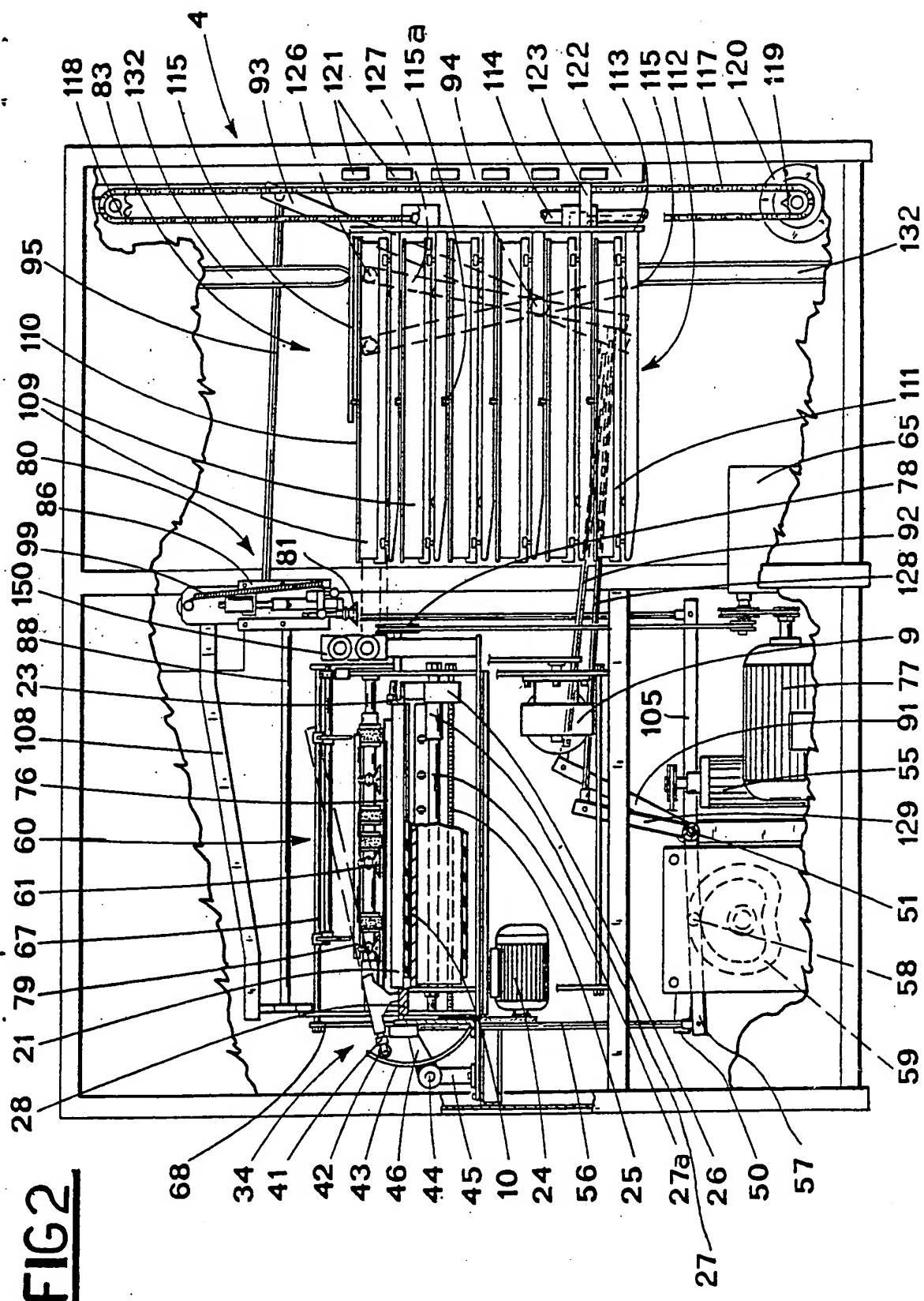
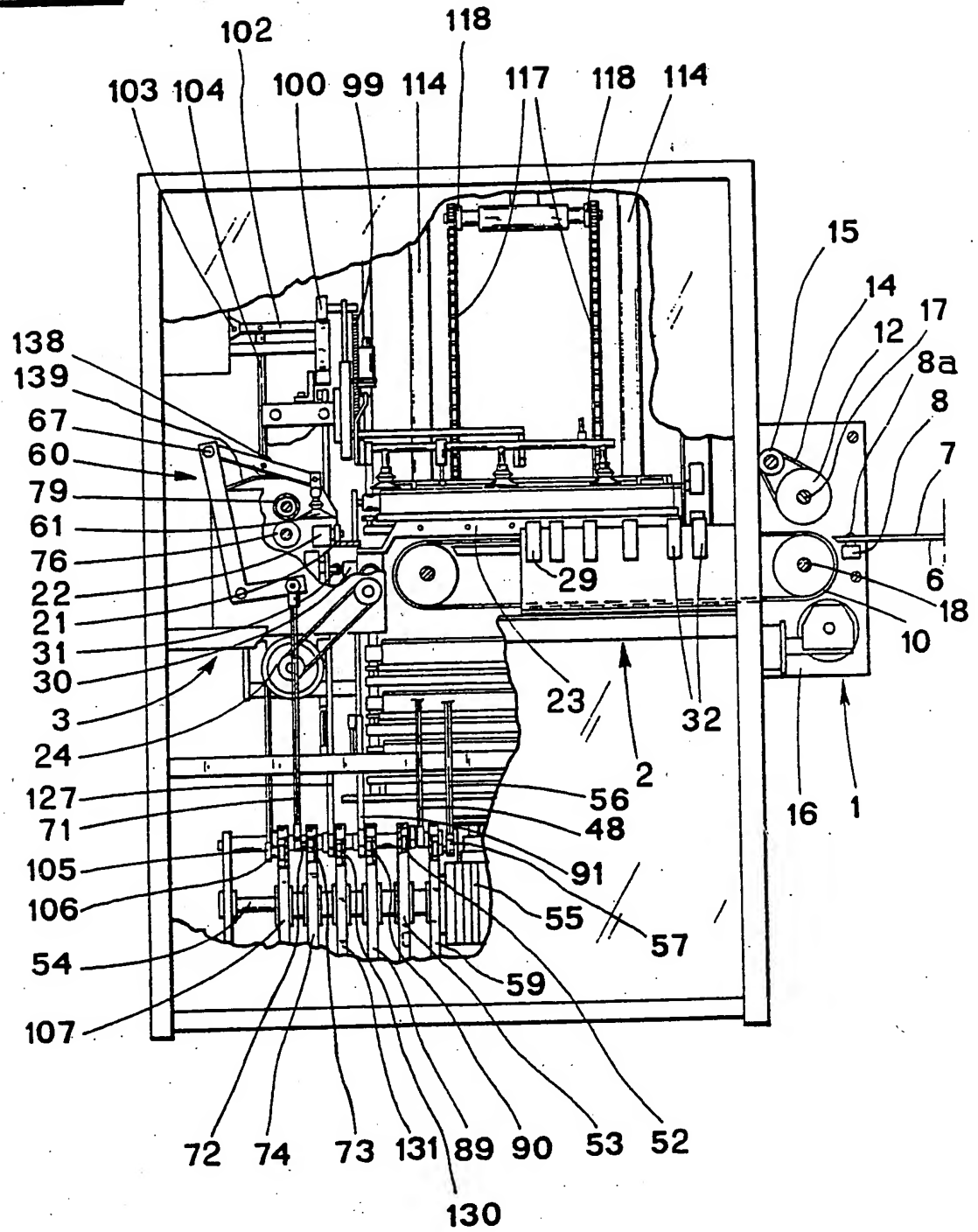


FIG3

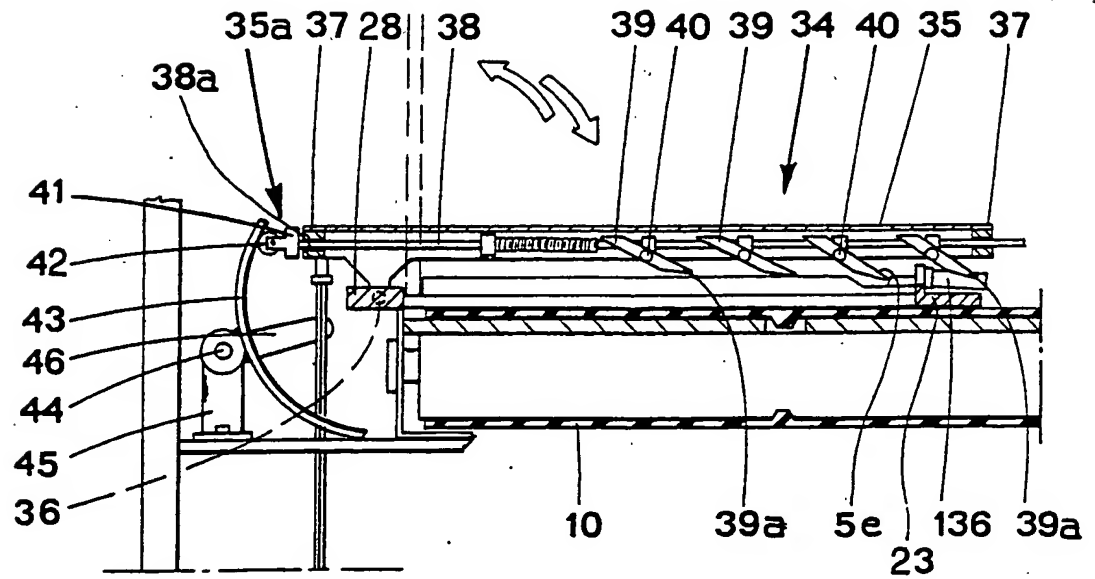


FIG 4

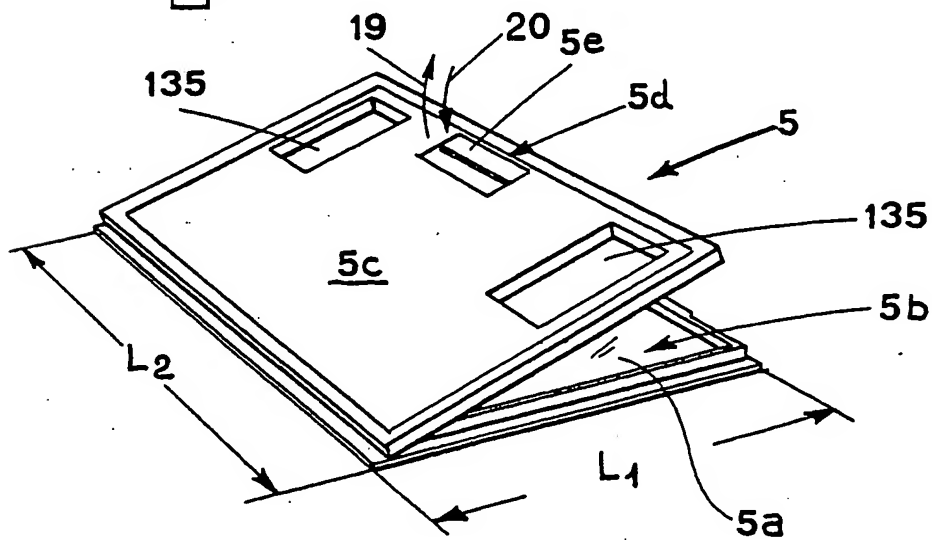
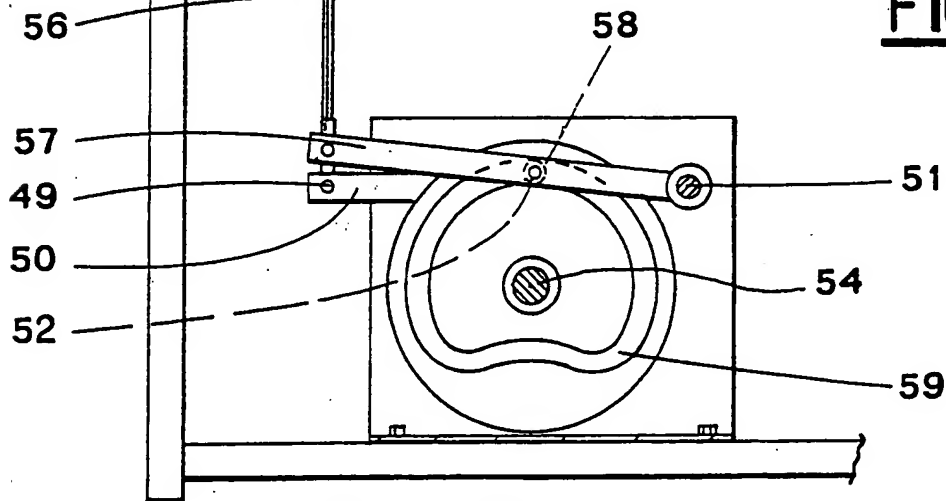
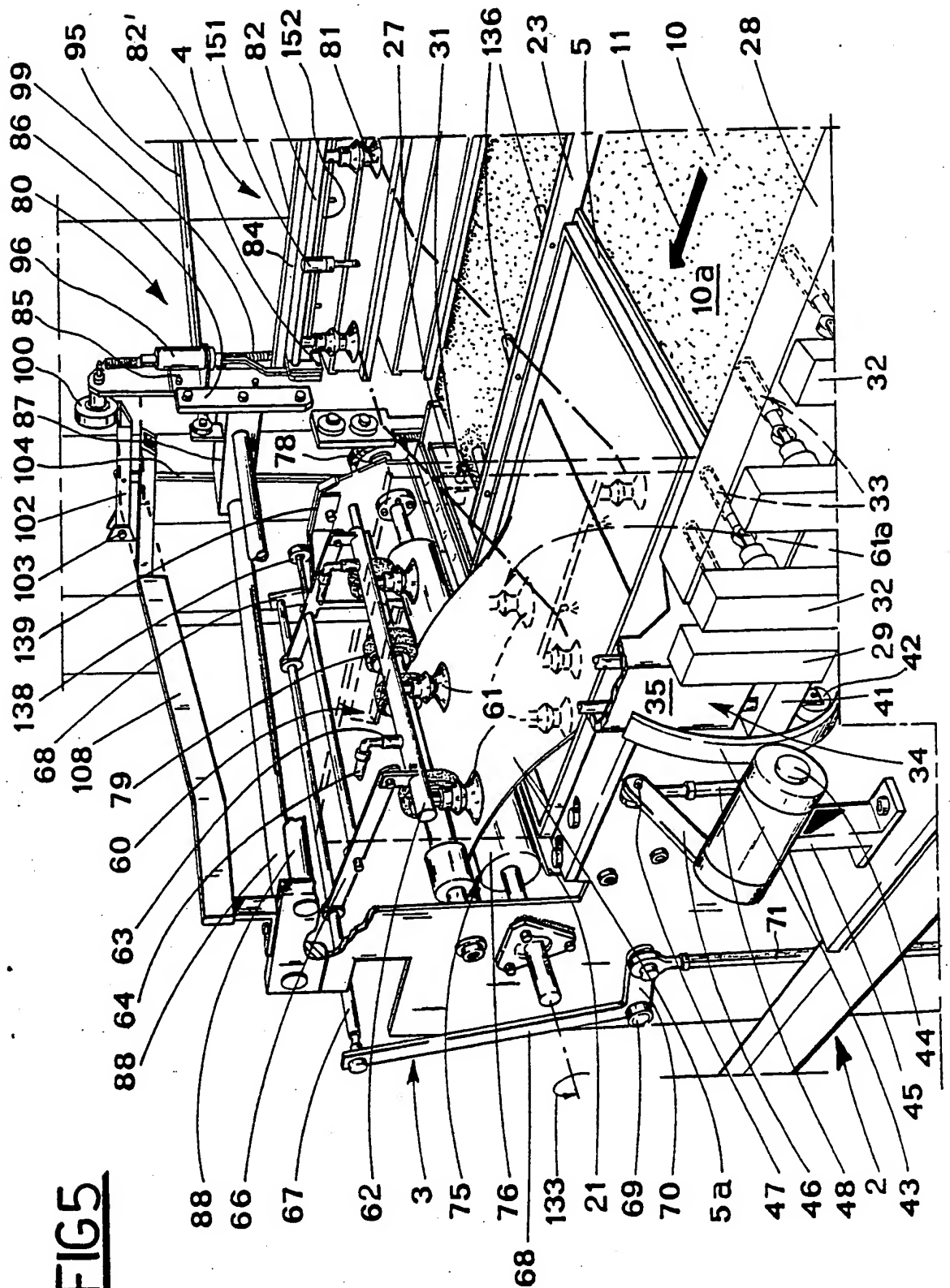


FIG 8

FIG5



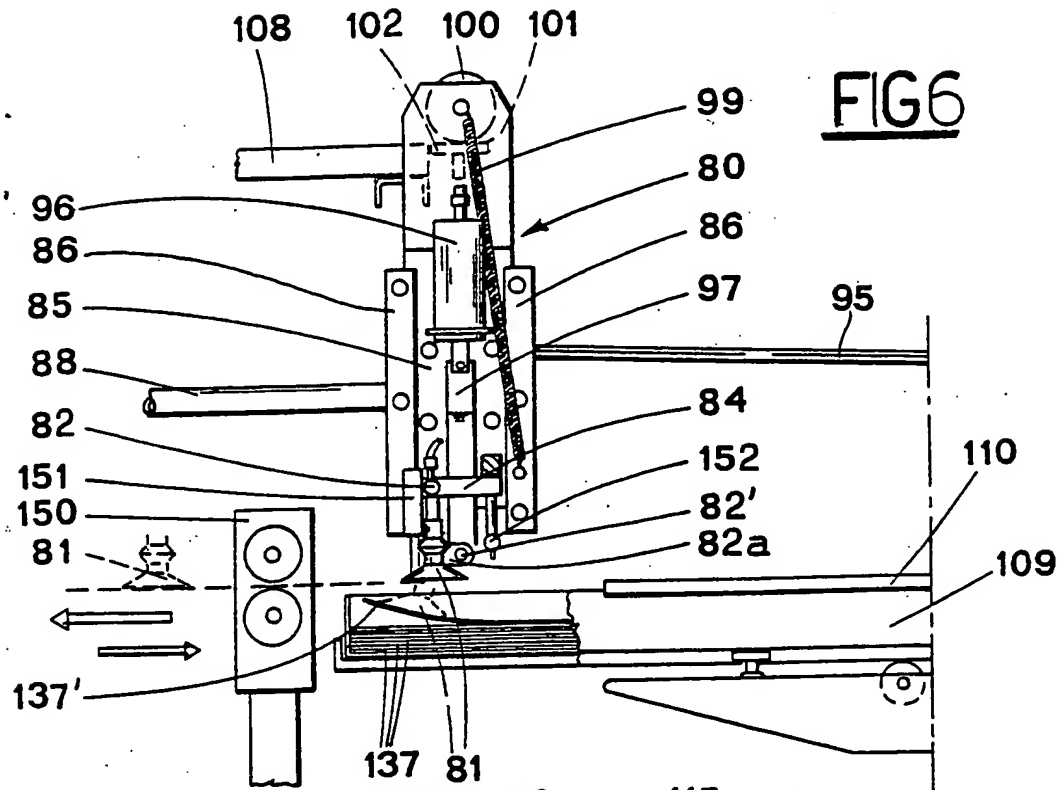


FIG 6

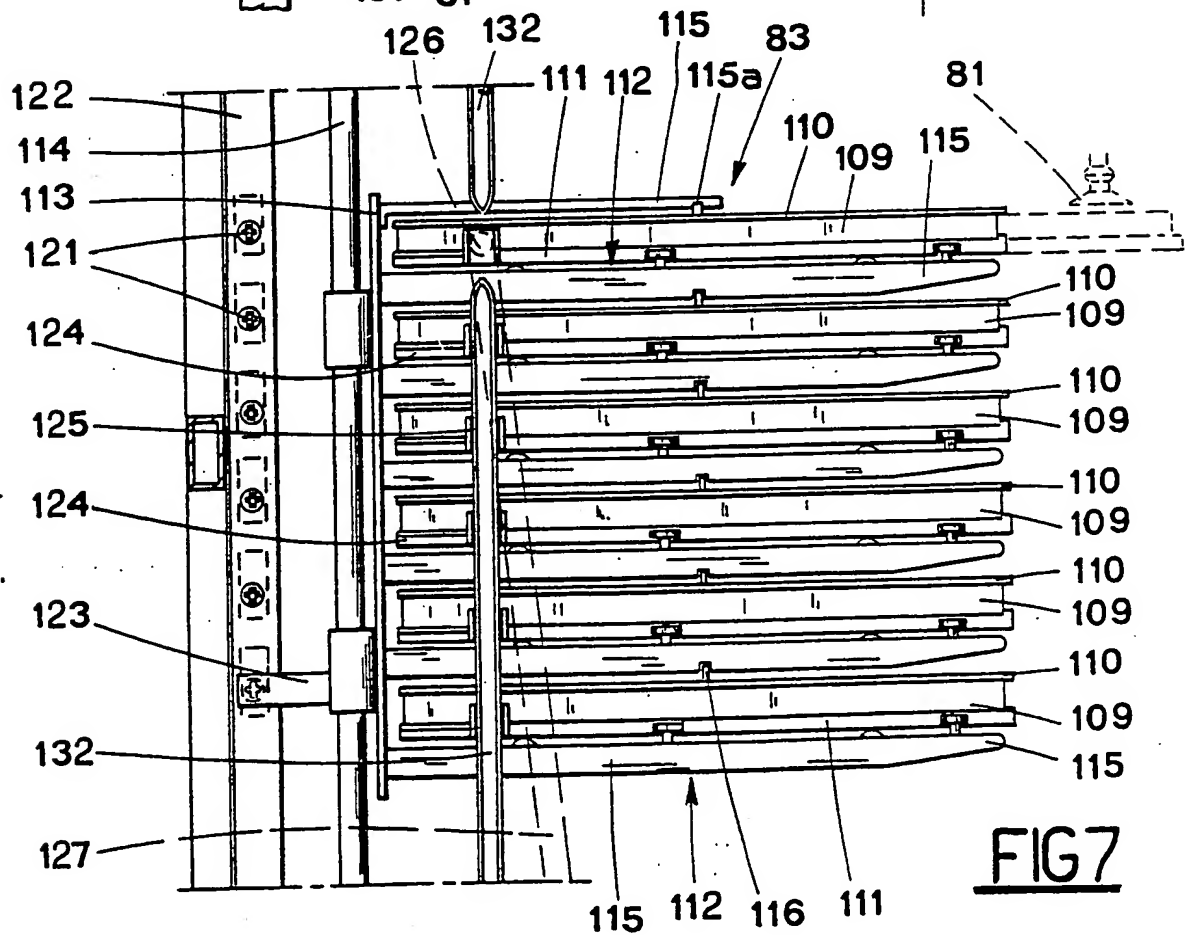
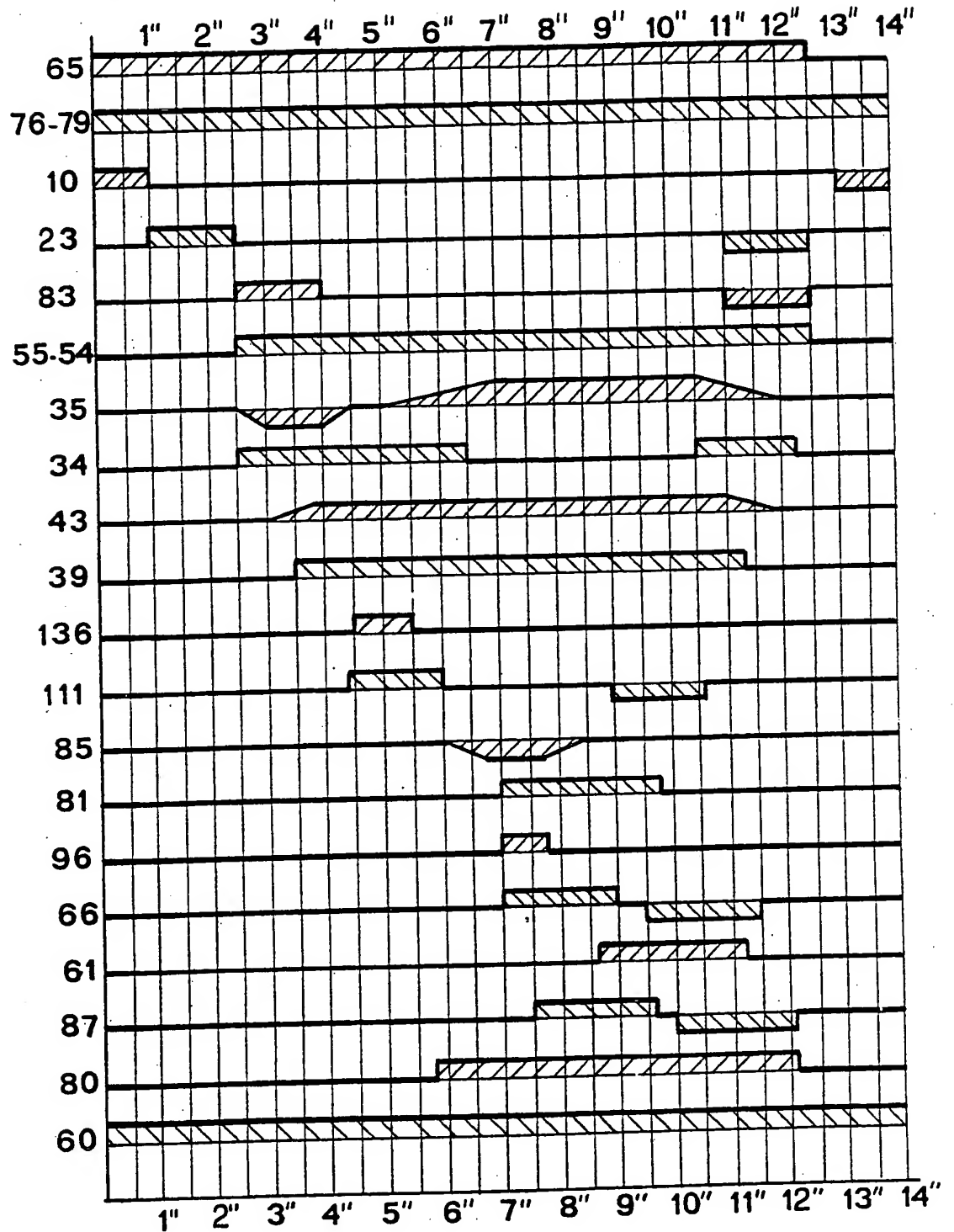


FIG 7

2068586

7/7

FIG9



SPECIFICATION

Automatic Machine for Loading and Unloading
Films in Radiography Cassettes

This invention concerns an automatic machine
5 for loading and unloading films in radiography
cassettes, where it is necessary to withdraw an
exposed film from the cassette and insert a new
film.

Machines are at present used to carry out
10 these operations by means of which the opening
of the cassette, the withdrawal of the exposed
film and its transmission to a suitable developing
apparatus, the withdrawal of a fresh film of
suitable format from a suitable magazine and its
15 systemization in the open cassette and the
closing of the reloaded cassette are carried out
inside the machines, in darkness, and are
operated by mechanical members which function
in phase with one another, without entailing any
20 direct assistance from the operator.

Normally, the known machines comprises a
first station for inserting the cassette in the
machine, followed by a second station, or dark
room, where special detecting members detect
25 the dimensions of the cassette inserted, which
rests, at a standstill, on suitable conveying
devices. These detecting members are arranged
to detect, on a plane, only one cassette
dimension, e.g. length, or two dimensions, length
30 and breadth.

The magazine for films to be inserted in the
cassettes gradually inserted in the machine
comprises a series of film-holder cassettes which
make it possible to have different film formats
35 available for the widest versatility in machine use.
Said cassettes are arranged on different levels
above that of the cassette inserted in the
machine. To carry a film of desired format inside
the cassette, the abovementioned detecting
40 members control operation of detection devices
arranged in correspondence to each of said film-
holder cassettes and start up only those relating
to the cassette containing the films of the
cassette format detected. While the film is being
45 withdrawn from the magazine, other operational
devices, arranged in the second station, open the
cassette, lift the relevant cover, withdraw the
exposed film contained in the cassette and send it
to the transfer devices connected to the
50 apparatus for development.

The film covers the entire route to reach the
development apparatus in darkness.

As mentioned, the film magazine is arranged at
a level above that of the cassette inserted in the
55 machine. To convey the films gradually
withdrawn from the film-holder cassettes to the
cassette inserted in the machine, known
machines foresee that said withdrawal devices
have associated corresponding transportation
60 devices which send the films to relevant
collectors, the respective output openings of
which are arranged corresponding to, and above,
the cassette inserted in the machine, where the
films fall freely inside said collectors. The film-

65 holder cassettes are positioned in the magazine in
such a way that they are always open and
prearranged to permit a film to be withdrawn
from them, or closed and able to be opened only
at the moment in which a film must be withdrawn
70 from them.

In this second case, the known machines are
equipped in correspondence with each cassette,
and with opening devices operated by the
abovementioned detection devices, of the same
75 format as the cassette inserted in the machine.
Obviously, this second condition offers better
guarantees of good film conservation.

On completion of cassette reloading, special
devices close it immediately before, or during, its
80 transfer outside the machine. Normally, the
station in which the cassette is inserted in the
machine also acts as a receiving station for the
reloaded cassette.

Although machines with this structure consent
85 a notable technical progress as compared with
the times in which all the abovementioned
operations were carried out by an operator who
had to work in a dark room, they present various
drawbacks, the first being that a notable number
90 of devices are required to open and close the film-
holder cassettes and withdraw the films in the
magazine from same. In fact, each cassette is
equipped with an opening and closing device and
a film withdrawal device, their operation
95 depending on the format of the cassette inserted
in the machine. For all this, a notable number of
control members and interconnections and
connections with the abovementioned detection
devices are required in the machine to obtain the
100 desired operation. Also, with the films which, after
being carried to the collectors, are conveyed to
the cassette, by simple, free fall, it may happen
that, for various reasons, they fail to reach the
cassette arranged correctly, with the risk of
105 damaging these films and notably prejudicing
machine operation.

The main purpose of this invention is to put a
stop to the abovementioned drawbacks, and, in
particular, to supply an automatic machine to load
and unload films in radiography cassettes, in
110 which, once the format of the cassette inserted in
the machine has been detected, by means of a
single detection device, the films stored in the
magazine and withdrawn from the film-holder
cassette containing formats coinciding with that
of the cassette, are carried directly inside the
cassette and where also the magazine, controlled
by said detection device, is prearranged to
present the desired film-holder cassette
115 corresponding to said detection device.

Another purpose of this invention is to supply a
machine of the type indicated, where the film-
holder cassettes forming the magazine, which
remain closed when the machine is off, up to such
125 a time as a desired cassette reaches a point
corresponding to that of the film withdrawal
device, are opened, each time, by a single device,
which, pushing a carriage on which the cassette
rests, opens said carriage and prearranges the

package of films contained in it for a film to be taken by said withdrawal device.

Yet another purpose of this invention is to supply a machine of the type indicated, equipped with devices which ensure that the film already in the cassette is not drawn from same in the cover lifting phase.

Another purpose of this invention is to supply a machine of the type indicated, which has an extremely simple construction, is safe to operate and cheap to produce.

Said purposes are achieved by the automatic machine to load and unload films in radiography cassette comprising: a first operation station, containing devices to insert cassettes individually in the machine and expel the reloaded cassettes from same; a second operation station, following the first, containing at least one conveying device and at least one pusher which bring the incoming cassette to foul at least one striker device with associated cassette format detection devices, a device to open the cassette positioned alongside and above said conveying device, and devices to withdraw the film from the open cassette and transfer it to the transfer devices which send it to a developing apparatus; a third operation station in which said transfer devices are positioned, and a fourth operation station containing a magazine to hold different film formats, characterized by the fact that said fourth operation station is positioned alongside the second operation station, with said magazine alongside said radiography cassette conveying devices, opposite the one containing the device which opens the cassette, said magazine consisting in a series of identical film-holder cassettes positioned, at different levels, one on top of the other, each resting on a relevant carriage, sliding, alternatively, in the direction of the second operation station with respect to the same number of frames supported by a supporting plate located behind said frames, sliding vertically and alternatively on slides fixed to the machine frame; said supporting plate equipped with stylus element on the line joining the sensitives in a series of level signalling microswitches, one on top of the other, spaced at the same distance as the surfaces on which said cassettes rest on their carriages. These microswitches are inserted in the input circuit of a geared motor, through which upward then downward movement of the abovementioned supporting plate, and therefore of the whole mechanism, is achieved, although, with the devices detecting the format of the cassette inserted in the machine, to lock the upward magazine movement when said stylus reaches the position where it intercepts the sensitive of the level signalling microswitch relating to the cassette containing films of suitable format for that detected by the radiography cassette, corresponding to the positioning of said cassette in correspondence with a device to withdraw a film from same and its successive transfer inside said cassette, arranged alongside said device conveying the

latter from the same part of the magazine, operating above said conveying device. The carriages on which the film-holder cassettes rest, forming the magazine, are laterally equipped with corresponding coupling elements, which slide into, and are engaged with a vertical slide positioned alongside the magazine, interrupted in the intermediate section at a height corresponding with that of said device to withdraw the film from the cassette and transfer it to the radiography cassette. Said insertion area contains a device which is engaged with the coupling element relating to the carriage carrying the film-holder cassette to correspond to the device to withdraw a film from it and the successive transfer of same inside the radiography cassette. When the magazine is at a standstill, said device is mobile, moving either in the direction of the second operation station to drag the carriage concerned from a completely rear position, with the relevant film-holder cassette resting on it closed, to a position in which it brings said cassette, open, below said devices to withdraw a film, then transferring it inside a radiography cassette and thus back to the initial position.

The pusher which brings the cassette to foul a striker element, and associated format detecting devices, arranged alongside said radiography cassette conveying device on the side opposite that in which the device opening the same cassette operates, is equipped with at least one inner probe, positioned for insertion below the cover closing the cassette in its initial opening phase to detach the film in the cassette and accidentally adhering to same, from said cover. The machine with the abovementioned structure in this invention offers the advantage of an extremely simple construction, due to the limited number of operational devices required for its operation and also that, thanks to the solution which permits direct, controlled transfer of the films from the magazine to the cassette inserted in the machine, it ensures perfect operation besides a notable reduction in the operative times required for each complete operational cycle, with the consequent advantage that it is cheaper to run than known machines.

The characteristics of the machine invented will now be illustrated in the following description of a preferred form of production, referring to the enclosed drawings in which:

Figure 1 is a schematic diagram of the abovementioned machine, showing a perspective view of the part in which the cassette is inserted or withdrawn, with cutaway sections to enhance the others;

Figure 2 is a schematic diagram showing the front view of the abovementioned machine with cutaway sections;

Figure 3 is a schematic diagram showing a side view of the abovementioned machine from the side opposite the one in which the film magazine is positioned;

Figure 4 is a schematic diagram showing a side view of a detail of the abovementioned machine,

i.e. the device which opens and lifts the cassette cover;

Figure 5 is a schematic, perspective view of the device to withdraw films from the cassette and the device to withdraw films from the magazine;

Figure 6 shows a front, enlarged view of the detail A in Figure 5;

Figure 7 is a schematic diagram of the film magazine and a side view of the device to open the relevant cassettes, viewed from the opposite part to that illustrated in figure 2, with cutaway sections;

Figure 8 is a perspective view of a new type of radiography cassette which may be unloaded and reloaded by the abovementioned machine;

Figure 9 is a schematic diagram of the intervention phase of the devices operating the machine, referring to a complete cassette unloading and reloading cycle.

In these figures, in particular figures 1 and 2, the abovementioned machine is mainly composed of the following operation stations:—

a first operation station 1 to insert the radiography cassette in the machine and receive the same cassette, reloaded, from the machine;

a second operation station 2, positioned to follow the first, according to the forward direction of the cassette 5 entering the machine, where, as we will see later, the cassette with the exposed film is withdrawn and reloaded with a new film taken from a magazine;

a third station 3, positioned to follow the second station 2, where the conveying devices send the films gradually unloaded to a developing apparatus and a fourth station 4, positioned alongside the section station, where the machine magazine is located.

Stations 2, 3 and 4 are all shielded from the light to avoid film alteration.

In the first operation station 1, a loading level 6 is foreseen with a supporting surface 7 for insertion of the cassette 5, containing the exposed film 5a, in the machine and receive the same cassette reloaded. The sensitives 8a of one microswitch 8 or more are positioned in correspondence with the loading level 6, and, intercepted by the cassette 5, and pushed towards the second station 2, they control starting of a geared motor unit 9 operating a conveyor belt 10, which is developed towards and inside the second station 2. The continuous conveyor belt 10, as will be explained more fully later, is motorized in the insertion phase of cassette 5 in the second station 2 so that the upper conveying surface 10 moves in the direction of the arrow 11, while, in the expulsion phase of the reloaded cassette 5, it moves in the opposite direction from the machine.

The number 12 indicates a series of soft rubber rollers with cylindrical surfaces. Said rollers 12 are positioned to correspond to the first station 1, above the continuous conveyor belt 10, and to cooperate with it in inserting and expelling the cassette 5 in and from the second station 2.

Corresponding pulleys 13 are associated with

said rollers 12 but have a lower diameter than the latter; on these corresponding pulleys 14, closed by a ring, are partially wound, these also being wound on the same number of transmission pulleys 15 supported by a frame 16 fixed to the base frame of the machine. The frame 16 also supports the shaft 17, on which the rollers 12 and pulleys 13 are keyed, and the shaft 18 of the motor roller of the continuous conveyor belt 10. In the expulsion phase of the cassette 5 from the second room 2, the pulleys 14 and rollers 12 function, as will be seen later, as a closing device for the same cassette. Before proceeding with the description of the machine and the purposes, to facilitate the description and function of the operating members in the second station 2, a brief description will now be given of a known type of radiography cassette suitable to be unloaded and reloaded by the abovementioned machine.

The cassette 5 is of the type with an internal space 5b, in which the radiography film 5a is positioned, closed by a cover 5c hinged along one side of the cassette, equipped on the opposite side with a locking mechanism 5d to open and close the cassette 5, operated by a trigger 5e flag-jointed to the cover 5c, moving in the two directions indicated by the arrows 19 and 20.

To open the cassette 5, the trigger 5e must be turned in the direction of the arrow 19 until the cover 5c is loosened, then this cover lifted and turned around the hinging axis to the cassette 5.

The abovementioned machine foresees a first striker 21 in said station 2, in corresponding position to the rear end of the continuous conveyor belt 10 to receive the incoming fouling cassette 5. Near the striker 21 a microswitch is also foreseen, which controls stopping of the geared motor unit 9 and therefore of the continuous conveyor belt 10, when the cassette 5 fouls the striker 21. The number 23 indicates a pushing device positioned alongside and above the continuous conveyor belt 10 in the area connecting the second and third operation stations 2 and 3 of the machine. The purpose of the pusher 23 is to bring the cassette 5, fouling striker 21, to a position where it is subject to the action of format detection devices and devices to open the cover 5c, which will be described later.

The pusher 23 is operated in such a way that it moves alternately, transversally and above the continuous conveyor belt 10. It is operated by a motor 24, see figures 2 and 3, kinematically connected to a screw 25 revolvingly supported by the machine frame. The screw 25 engages a threaded bush 26 fixed to a support 27 sliding on slides along a shaft 27a parallel to the screw 25, also supported by the machine frame. The pusher 23 is associated with said support 27. Depending on the direction in which the screw 25 of the motor 24 rotates, the pusher 23 will be translated in one direction or the other, transversally and above the continuous conveyor belt 10.

In its outward course, which corresponds to a translation from right to left observing figure 2,

the pusher 23 causes the cassette 5, already against striker 21, to foul a second striker 28 arranged alongside the continuous conveyor belt 10 on the side opposite that from which the pusher starts. A microswitch 29, inserted in the feed circuit of the motor 24, is arranged to correspond to the striker 28.

When the cassette fouls the striker 28, the microswitch 29 stops the motor 24 and therefore also the pusher 23.

The abovementioned machine is preset to detect the format of the cassette 5 inserted in the second station 2 by measuring its breadth and length, indicated in figure 8 as L_1 and L_2 . The breadth L_1 is measured during the outward course of the pusher 23 by means of a stylus 30 associated with the support 27, which intercepts, at successive times, a series of microswitches 31, arranged in consecutive lines in correspondence with the second striker 28, its sensitives being subject to the action of the respective actuators 33 passing through the striker 28, positioned for interception by the cassette 5 when this fouls the same striker 28.

The microswitches 31 and 32, intercepted by the stylus 30 and the cassette 5 respectively, detect the format of said cassette 5, and, as will be explained more fully later, preset the machine magazine to supply a new film of suitable format for said cassette.

A description will now be given of the device shown in figures 1, 2, 3, 4 and 8, which opens the cassette 5 when it fouls the strikers 21 and 28. This device is always indicated with the number 34 and comprises an arm 35, articulated in 36 to the machine frame, equipped at its ends with supports 27 to support, in a smooth-running way, a couple of rods 38. Each rod 38 supports a series of coupling elements 39, arranged consecutively, suitably spaced to form couples on the same line.

The coupling elements 39 are balance-jointed in 40 to the rods 38 to rotate around the respective joints pins and to result flexibly with their front end 39a facing downwards. To ensure that the coupling elements 39 are in equal position, their rear ends are in contact with the inner surface of the upper wall of the arm 35 so that they are capable of working on cassettes 5 with different breadths L_1 and lengths L_2 .

The rods 38 are interconnected to correspond to the rear ends 38a, by means of the strip 41, forming a rear projecting support to a pin 42, engaging a curved slide 43. The slide 43 is fixed to the end of a pin 44 with axis normal to the axis of the rods 38, revolvingly supported by a support 45 fixed to the machine frame. At the other end of the pin 44, an arm is fixed to the end of a tie-rod 48 primed in 47, the other end being articulated in 49 to the free end of a lever 50 pivoted on a shaft 41, supported by the machine frame and carrying a pin 52, engaged in the shaped race of a cam 53. The cam 53 is keyed on a shaft 54, started by a geared motor 55, also supported by the machine frame. The curved race 43 is arranged in such a way that, as will be seen later,

when the tie-rod 48, activated by the cam 53, causes the arm 46 to rotate downwards, it comes to rest on a curved trajectory with centre in the point 36, articulating the arm 35 to the machine frame, causing a relevant forward translation of the rods 38 with respect to the arm 35.

The purpose of the coupling elements 39 is to operate the trigger 5a, which frees the locking mechanism 5d of the cassette closing cover 5c to allow said cover 5c to be lifted. To lift same, the rear end 35a of the arm 35 engages the tie-rod 56, to the lower and free end of a lever 57 pivoted on the shaft 51.

The lever 57 carries a pin 58, engaged in the shaped race of a cam 59 keyed on the shaft 54. The race of the cam 59 is shaped in such a way that the arm 35 goes, in suitable times, from the position illustrated by the continuous line in figure 4 to that illustrated by the broken line in the same figure 4, to then return to the initial position. A description will now be given of the device shown in figures 1, 2, 3 and 5, which withdraws the film 5a from the open cassette 5 and sends said film to a developing apparatus, not shown in the enclosed drawings.

Said withdrawal device, always indicated with the number 60, is foreseen in the third operation station 3, operates above the continuous conveyor belt 10 and comprises a series of feeding suckers 61, associated with a tubular cross member connected to a second apparatus 65 by means of pipe 64 connections 63a (see figure 2). The feeding suckers 61 are suitably spaced and are foreseen in sufficient number to succeed in withdrawing different film formats. The feeding suckers 61 will be positioned taking into account the length of the various films.

The cross member 61 is supported by a frame 66, the rear cross member being bilaterally connected to the free end of a couple of arms 68, which form the same number of levers pivoted in 69 to the machine frame. One of said levers (see figure 3) is squared and one of the ends of the tie-rod 71 is connected to the arm 70, positioned at an angle to the arm 68, the other end, see figures 1, 2 and 3, being articulated to the free end of a lever 72 pivoted on the shaft 51. The lever 72 carries a pin 73, engaged in the shaped race of a cam 74 pivoted on the shaft 54. The feeding suckers are moved by the cam 74 from the position illustrated by the continuous line in figures 1, 2, 3 and 5 to the position 61' indicated by the broken line in figure 5, to which the drive of the film 5a housed in the cassette 5 corresponds, and their return to the initial position, with corresponding withdrawal of the film 5a from the cassette 5 and its insertion in a transfer device 75 which sends it to the developing apparatus. This is due to the fact that, by means of a pin 138, the frame rests constantly on a shaped slide 139, which makes it possible to achieve the abovementioned movements during the return course of the same frame 66. The drawing device 75 comprises a roller 76, supported by a machine frame, rotated by a geared motor 77 which also

operates the suction apparatus 65, kinematically connected to the pulley 76 keyed to one shaft end in said roller, and a series of rollers 79 operating in contrast with the same roller 76. The roller 76 and the contrast rollers 79 are in soft material to avoid damaging the film 5a.

With particular reference to figures 1, 5 and 6, a description will now be given of the device foreseen to withdraw a film from the magazine and transfer it into the cassette 5. All these devices are indicated with the number 80 and comprise a series of feeding suckers 81 supported by a cross member 82, which stretches out in front of, and near, the machine magazine.

indicated with the number 83, of which more will be said later, and above the continuous conveyor belt 10.

The cross member 82 is bilaterally articulated in 82' to a frame 84 associated with a sliding block 85, which slides within a vertical slide integral to the carriage 87. The carriage 87 slides alternately on two bars 88 supported by the base frame of the machine, developing normally in the movement direction of the continuous conveyor belt 10 above the withdrawal device 60.

The carriage 87 is started by a cam 89 keyed on the shaft 34, its shaped race being engaged in a pin 90 carried by a square lever 91 pivoted on the shaft 51. Said squared lever 91 is connected by means of a tie-rod 92 to another lever 93 pivoted in 94 to the machine frame. The lever 93 is connected to the carriage 87 by means of a tie-rod 95.

The cross member 82 is subject to the action of a small pneumatic piston 96, supported by the sliding block 85 and its shank is connected by means of a rod 97 to an arm of lever 82a (see figure 6) integral to the same cross member 82. The movement of the small pneumatic piston 96 causes angular displacement in both directions of the feeding suckers 81 around articulation points 82', for reasons which will be explained together with the description of the machine function.

The sliding block 85 is subject to the action of a spring 99, which, when the device 80 is in the starting position, tends to maintain a pin 100, associated with the same sliding block 85, against a bearing 101 presented by a lever 102 pivoted in 103 to the machine frame. The lever 102 makes the downward translation of the sliding block 85 possible in suitable times to permit the feeding suckers 81 to place a film on and withdraw a film from the magazine 83 each time and then to bring everything back to the initial position with consequent withdrawal of said film from the magazine. For this purpose, the lever 102 is connected by means of a tie-rod 104 to another lever 105 pivoted on the shaft 51, carrying a pin 106 which is engaged in the shaped race of a cam 105 keyed on the shaft 54.

The number 108 indicates a shaped slide developing above the bars 88 on which the pin 100 associated with the sliding block 85 slides during translation of the carriage 87 in both directions.

The slide 108 is shaped in such a way that, during the forward translation of the carriage 87, to which the transfer of the film withdrawn from the magazine 83 from said magazine to the cassette 5 corresponds, permits the gradual downward translation of the sliding block 85 to allow the feeding suckers 81 to directly support the film withdrawn inside the cassette 5.

A description will now be given of the various sections of the magazine 83 shown in figures 2 and 7 for different film formats to be carried into the cassette 5 as these are gradually inserted in the machine.

The magazine 83 is positioned in the fourth operation station 4 and consists in a series of identical film-holder cassettes 109 arranged on different levels, one on top of the other. Each cassette 109 is equipped with a closing cover 110 with respect to which it may slide longitudinally in both directions towards the operation station 2.

Each cassette 109 rests on a carriage 111 supported by a corresponding frame 112, with the possibility of sliding guided in both directions with respect to the latter only in the direction of the second station 2 and therefore in normal direction to the movement direction of the continuous conveyor belt 10.

The frames 112 are bracket-supported by a supporting plate 113 constrained in a smooth-running way to a couple of vertical rods 114 fixed to the machine frame, each comprising a couple of parallel bars 115 which are developed above the relevant carriage 111.

Consequently, when a desired carriage 111 slides towards the second station 2, the cassette 109 will slide forward, resting on it, with respect to its cover 110, which remains engaged in the bars 115, thus opening said cassette 109. As mentioned above, the magazine 83 is suitable to contain films of different formats. For this reason, the various cassettes 109 are internally equipped with dividing elements, not shown in the diagrams, forming compartments to contain films of the required format.

A desired cassette 109 must be brought to the working height of a withdrawal device 80 in relation to the format of the cassette 5 inserted in the machine and detected by the microswitches 31 and 32.

For this purpose, a supporting plate 113 is coupled to a couple of chains 117 wound around serrated transmission teeth 118 and 119, the 118 teeth supported by the machine frame, and the 119 teeth keyed on the output shaft of a geared motor 120 fixed to the base of the machine.

According to the rotation direction of the shaft of the geared motor 120, there will be an upward or downward translation of the magazine 83, with the possibility of bringing the cassette 109 containing the films of desired format to the working height of the withdrawal device 80. To stop the geared motor 120, when a desired cassette 109 reaches the working height of the

withdrawal device 80, a series of level signalling microswitches 121 are foreseen inserted in the feed circuit of the geared motor 120, connected to the microswitches 31 and 32 which detect the cassette format. The microswitches 121 are fixed at different levels, one on top of the other, to a vertical bar 127 parallel to the vertical rods 114.

The number of microswitches equals that of the cassettes 109 and they are spaced at a value equal to the distance between the surfaces on which the cassettes 109 rest on the carriages 111.

The microswitches 121 are also arranged in such a way as to be intercepted by a stylus 123 fixed to the supporting plate 113.

As mentioned in the introductory part of the description, it is only possible to open a desired cassette 109 when this cassette reaches the working height of the withdrawal device 80 and the machine concerned foresees a single device to open all cassettes as they are carried to said position. According to the solution illustrated in figures 2 and 7, on the side of each carriage 111 opposite that facing the microswitches 121, is an arm 124 to which a coupling 125 is associated with which it is free to be engaged, when a desired cassette 109 reaches the working height of the withdrawal device 80, a pin 126 primed to the upper end of a lever 127 also pivoted in 94 to the machine frame. The lever 127 is connected by means of a tie-rod 128 to one of the arms of a squared lever 129 pivoted on the shaft 51 carrying, at the free end of the other arm, a pin 130 which is engaged in the shaped race of a cam 131 keyed on the shaft 54. The cam 131 causes the lever 129, and therefore the lever 127, to oscillate around its fulcrum and consequently the translation in one direction or the other of the carriage relating to the cassette concerned, thus, as already mentioned, opening and closing the same cassette.

The number 132 indicates a vertical slide fixed to the machine frame in which the couplings 125 are constantly engaged in a smooth-running way in the carriages 111 in a rear position, i.e. with the cassettes 109 closed. The slide 132 is positioned on the same level as the pin 126 or is interrupted correspondingly to same to permit the only carriage relating to the cassette 109, carried to the working height of the withdrawal device 80, to slide in both permissible directions. Since we have described up to now all sections of the machine in this invention, we will now describe how it functions, referring to the diagram of its phases illustrated in figure 9. In the diagram in figure 9, the stopping and intervention times involved for the various devices are shown in abscissa, considering that the time involved to carry out the complete loading and unloading cycle of a cassette 5 is 14 seconds, while the movements of some organs are shown in ordinate with sloping lines.

It should also be noted that the shaft 54 on which the cams 53, 59, 74, 89, 107 and 139 are keyed, has an associated programmer not shown

in the diagrams, to which the motor organs of the machine are subject and which determines the times and phases of their intervention.

The following starting situation should be considered with the machine off. The geared motor 77 is at a standstill and therefore the suction apparatus 63 does not function; the roller 76 of the withdrawal device 60 is at a standstill, the geared motors 9, 55 and 120 are at a standstill and the opening device 34 is therefore in a slightly raised position, the pusher 23 and the withdrawal devices 60 and 80 are in the starting position shown in figure 3 and the magazine 83 is in the maximum downward translation position.

When a cassette 5 is brought to rest on the loading surface 6 and pushed against the microswitches 8, the latter, intercepted, start the geared motor 9, which starts up movement of the continuous conveyor belt 10 and the geared motor 77, which operates the suction apparatus 65 and starts the roller 76 of the withdrawal device 60 rotating in the direction of the arrow 133 in figure 5. The cassette 5 is thus drawn from the continuous conveyor belt 10 and the rollers 12 into the second operation station 2. When the cassette 5 reaches the striker 21, it intercepts the microswitch 122 which stops the geared motor 9 and therefore the continuous conveyor belt 10 and starts the motor 24 which rotates the screw 25.

Consequently, the pusher 23 translates from right to left above the continuous conveyor belt 10, pushing the cassette 5 against the second striker 28. When the cassette 5 fouls the striker 28, the microswitch 29 stops the motor 24 and therefore the pusher 23, while one or more microswitches 31, intercepted by the stylus 30, and one or more microswitches 32 activated by the actuators 33 fouled by the side of the cassette 5 which fouls the striker 28, detecting the dimensions L_1 and L_2 and therefore the format of the cassette 5. The microswitch 29 also starts the geared motor 120, which, by means of the chains 117, starts making the supporting plate 113 and thus the magazine 83 translate upwards.

The upward translation of the magazine 83 continues for the length of time in which the stylus 23 intercepts the microswitch 121, which, in relation to the cassette format detected by the microswitches 31 and 32, stops the geared motor 120 with the film-holder cassette 109 containing films of suitable format to that detected at the working height of the withdrawal device 80.

During this phase, the geared motor 55 starts up, causing rotation of the shaft 54 on which the cams 53, 59, 74, 89, 107 and 131 are keyed. The cam 59 provokes downward rotation of the arm 35 of the device 34 until it brings the coupling elements 39 to rest on the cover 5c. In this phase, considering the type of cassette 5 illustrated, a microswitch 134 fixed to the arm 35 checks that the cassette 5 has been correctly inserted in the machine. The cover 5c presents a sinking 135 (see figure 8), which, if the cassette 5 is incorrectly inserted in the machine, creates a

vacuum below the microswitch 134 and blocks its operation. In this case, the microswitch 134 stops the machine's operational cycle; the geared motor 29 is activated and starts the continuous conveyor belt 10 moving in the opposite direction to the previous one and the cassette 5, still closed, is expelled from the machine.

If, on the contrary, the microswitch 134 is stressed, the operational cycle proceeds regularly.

10 The cam 53 causes the curved race 43 to rotate in clockwise direction around the pin 44, see figure 4. In this way, due to the action of the race 43 on the pin 42, the rods 38 are pushed forward so that the coupling element 39, suitable to move the trigger 5e operating the locking device 5d of the cassette inserted, make said trigger rotate in upward direction, working its way below it, consequently opening the cassette 5.

20 At this point, the cam 59 causes initial upward rotation of the arm 35 so that the cover 5c is slightly raised; this rotation is followed by a brief pause and there is then a further rotation until the cassette is completely open with the cover 5c practically in vertical position. During said pause, a series of probes 136, suitably pneumatically controlled and associated with the pusher 23, see figures 2 and 5, work their way below the cover 5c and avoid the film 5a following this cover during cassette opening and keep it correctly positioned inside the cassette itself. During the opening phase of the cassette 5, the cam 131 provokes forward translation of the carriage 111 on which the cassette 109 rests, which has been chosen, as seen, in relation to the previous factors detected by the microswitches 31 and 32. The cassette 109 in question is thus opened and the package of films 137 is brought below and near the feeding suckers 81 of the withdrawal device 80. At this point, the cam 107 causes the lever 102 to move at a downward angle, with a corresponding downward course of the sliding block 85 until the feeding suckers 81 have adhered to the first film 137' of the package of films 137.

45 The feeding suckers 81 are activated at the same time as the small pneumatic piston 96, the shank of which, sliding downwards, causes the cross member 82 to rotate around the articulation points 82' so that the feeding suckers 81, sloping, detach the front edge of the film 137' adhering to them from the underlying film package 137. Immediately afterwards, the lever 102 returns to the initial position and the sliding block 85 thus translates upwards, drawing with it the feeding suckers 81 and the film 137' adhering to them.

55 While this phase is taking place, the small pneumatic piston 96 stops working and the cam 74 provokes a forward run of the frame 66 of the withdrawal device 60 to which the feeding suckers 61 are associated.

60 During this run, due to the fact that the pin 138 constantly follows the shaped slide 139, the frame 66 is initially displaced and therefore the feeding suckers 61 displaced below the cassette 5, followed by their sinking to the position 61a in

figure 5 in contact with the film 5a. At this point, the feeding suckers 61 are linked to the suction apparatus 65 and adhere firmly to the film 5a. Immediately afterwards, the cam 74 makes the frame 66 gradually regain its initial position, to which the direct transfer of the film 5a withdrawn from the cassette 5 between the rollers 76 and 79 corresponds (figure 5). In the meantime, the cam 89 provokes a forward run of the carriage 87 on the bars 88, with corresponding transfer, by the withdrawal device 80, of the film 137', withdrawn from the cassette 109 in question inside the cassette 5. Before the new film reaches the cassette 5, or at any rate when the frame 66 reaches the starting position, the feeding suckers 61 are deactivated and the film 5a, withdrawn from the cassette 5, is sent to the developing apparatus by the rollers 76 and 79.

85 When the carriage 87 reaches the maximum forward run position, the feeding suckers 81 are deactivated and the new film 137' is left already correctly arranged inside the cassette 5.

90 Before continuing the description of the machine's function, it must be noted that a device 150 is foreseen (see figure 5) through which the film 137' being transferred inside the cassette passes. This device controls that the feeding suckers 81 have not accidentally withdrawn extra films from the cassette 109 in question.

95 If the device 150 detects the abovementioned mistake, it signals the fact to the operator, who, when the cassette 5 comes out of the machine, arranges to recover one or more excess films. Furthermore, the device 80 foresees both a stylus device 151 to detect the absence of films in the cassette 109 considered of the magazine 83 and to signal this absence to the operator, and a series of nozzles on a tubular bar 152 positioned near the feeding suckers 81 through which, at the moment the film 137 is abandoned by said feeding suckers 81, jets of air are blown on the film to detach it from the feeding suckers 81 and insert it stably in the cassette 5. While the carriage 87, and therefore the withdrawal device 80, controlled by the cam 89, turn to their initial position, the cam 59 controls the downward rotation of the arm 35 and therefore the gradual sinking of the cover 5c to the closing position of the cassette 5. When the cover 5c reaches a position near the closing one, with the arm 35 in the starting position, the cam 53 starts the curved slide 43 rotating around the pin 44 in the opposite direction to the previous one. Consequently, due to the action of at least one spring 140, coaxial to each rod 38 and fouling a fixed striker 141 integral to the arm 35 and a relevant fouling ring 143 fixed to the rods 38, the axes themselves slide back from the arm 35 and the coupling element 39, which engaged the trigger 5e of the locking device 5d of the cover 5c of the cassette, is brought to a position in which said trigger is freed. The cover 5c therefore falls freely resting on the cassette 5. All these phases take place during a complete turn of the shaft 54

on which the cams 53, 59, 74, 89, 107 and 131 are keyed.

At the end of this rotation, all the organs operating the machine, including the magazine 83, will have returned to the starting position and the geared motor 9 is started, which starts the continuous conveyor belt 10 moving so that the conveying surface 10a draws the cassette 5 outside the machine.

In this phase, firstly by means of the belts 14 and then by means of the rollers 12, operating in contrast with the conveyor belt 10 on the locking device 5d, the cover 5c is released in closing position of the cassette 5, which leaves the machine ready for a new use.

Obviously, the invention is not limited to the constructive shapes described and illustrated and it is therefore understood that executory variations may be foreseen, all reentering within the protective ambit claimed below.

Claims

1. Automatic machine to load and unload films in radiography cassettes comprising: a first operation station in which devices operate to insert the cassettes, one at a time, in the machine and expel the reloaded cassette from same; a second operation station, arranged to follow the first, in which at least one conveying device and at least one pusher operate, which carry the incoming cassette to foul at least one striker element, with associated devices detecting the cassette format, a device to open the cassette arranged alongside and above said conveying device and devices to withdraw from the open cassette the film contained therein and transfer it to transfer devices which send it to a developing apparatus; a third operation station, containing transfer devices and a fourth operation station containing a magazine to hold different film formats to reload the cassette inserted in the machine, *characterized* by the fact that said fourth operation station is arranged alongside the second operation station with said magazine arranged on the side of said device conveying the radiography cassette opposite the one containing the device which opens the cassette, said magazine being composed of a series of equal film-holder cassettes, arranged at different levels, one on top of the other, each resting on a relevant carriage which slides alternatively and in the direction of the second operation station with respect to the same number of frames supported by a supporting plate arranged behind said frames, sliding vertically and alternatively on slides fixed to the machine frame; said supporting plate being equipped with a stylus element located on the line joining the sensitives of a series of level signalling microswitches, arranged one on top of the other and interspaced at a distance equal to that between the surfaces on which said cassettes rest on the relevant carriages, said microswitches being inserted in the feed circuit of a geared motor through which first upward then downward movement of the

abovementioned supporting plate and therefore of the whole magazine is obtained, even with the devices detecting the cassette format inserted in the machine to stop the upward movement of the magazine when said stylus reaches the interception position of the level signalling microswitch relating to the cassette containing the films of suitable format to that detected in the radiography cassette, to which the positioning of said cassette corresponds in correspondence with a device to withdraw a film from it and its successive transfer into said cassette, arranged alongside said device conveying the latter from the same part of the magazine and operating above the same conveying device.

2. Automatic machine, according to claim 1, characterized by the fact that the carriages on which the film-holder cassettes forming the magazine rest are equipped with side coupling elements engaged, in a smooth-running way, with a vertical slide arranged alongside the magazine and interrupted in the intermediate part at a height corresponding to that in which said device to withdraw the film from a cassette and transfer it to the radiography cassette is arranged, a device being present in said interruption area which is engaged in the coupling element of the carriage carrying the film-holder cassette, carried to correspond to the device withdrawing a film from it and successively transferring this to the radiography cassette, said device, with magazine at a standstill, being mobile, either in the direction of the second operation station so that it draws the carriage in question into movement from a completely rear position, with the relevant film-holder cassette resting on it closed, to a position in which it brings said cassette, open, below said device withdrawing a film from it and its successive transfer to the radiography cassette, and therefore once again in the initial position.

3. Automatic machine, according to the previous claims, where the film-holder cassettes forming the magazine are of the type closed on top by a sliding cover, characterized by the fact that the frames supporting the carriages on which the film-holder cassettes rest are each composed of an arm projecting above said cassettes and a slit in which a projection presented by the covers closing the cassettes themselves are engaged, said projection-slit coupling locking these covers to said frames.

4. Automatic machine, according to claims 1 and 2, characterized by the fact that the device withdrawing a film from the film-holder cassette brought to correspond with them and below them and transfer said film to the radiography cassette, comprises a series of suction devices supported by a cross member stretching out in front of the magazine, and interspaced to act on films of different formats, said cross member being articulated to a frame associated with a carriage moving alternatively in the direction of and inside the second operation station above the device conveying the radiography cassette from a position where said suction devices are arranged

above said film-holder cassettes opened to a position in which they are above the radiography cassettes and therefore once again in the initial position.

5 5. Automatic machine according to claim 4, characterized by the fact that said frame is associated with the mobile carriage by means of a sliding block which slides within slides fixed to the same carriage, said sliding block being engaged in
10 a couple of slides arranged above said mobile carriage, the first moving on a vertical plane, arranged in correspondence with the starting position of said mobile carriage, and the second, fixed, stretching out towards and inside the
15 second operation station, shaped to gradually approach the conveying surfaces of the device conveying the radiography cassette in upward direction, commencing from the height of the first slide in raised position, the first of said slides
20 consenting the suction devices to descend to a position in contact with, and to take up, the first film in the package contained in said film-holder cassette opened and arranged above them and then their return to the starting position, and the
25 second of said slides consenting, during the outward run of the mobile carriage, a gradual descent of the suction devices, and therefore of the film withdrawn, towards the radiography cassette, until it leaves said film resting inside
30 said cassette.

6. Automatic machine according to claims 4 and 5, characterized by the fact that said cross member which supports the suction devices is subject to the action of a small pneumatic piston associated with the sliding block which slides into
35 the slides fixed to said mobile carriage, its shank being connected to a lever arm integral to said cross member, said small piston causing, with the suction devices in the position where they adhere
40 to and take said film from the open film-holder cassette, a brief rotation of said cross member around the points articulating it to the relevant supporting frame so that it brings said suction device to an inclined position, lifting the front
45 edge of the actual film from the underlying package of films contained in the cassette concerned.

7. Automatic machine according to claim 4, 5 and 6, characterized by the fact that a stylus device is foreseen associated with the suction
50 devices arranged at the same height as the suction openings of these devices, to detect the absence of films in the cassette of the magazine carried, open, below the same suction devices.

8. Automatic machine according to claims 4, 5, 6 and 7, characterized by the fact that a series of blower nozzles are foreseen supported by a bar arranged to correspond to the suction devices,
60 operable only when a film withdrawn from a certain cassette in the magazine is abandoned by the suction devices inside the radiography cassette to facilitate the detachment of said film from the same suction devices.

9. Automatic machine according to the previous claims, characterized by the fact that a

device is foreseen to detect the number of films exceeding one withdrawn each time by the device withdrawing films from the magazine cassette and transferring them into the radiography
70 cassette, said device being arranged along the trajectory followed by said device during the transfer phase of the films from said cassette to the radiography cassette.

10. Automatic machine according to one or
75 more of the previous claims, characterized by the fact that, to open the radiography cassettes, of the type equipped with a closing cover hinged to them on one side, it foresees said device to open the cassette inserted in the machine comprising:
80 an arm arranged to stretch out above the device conveying the radiography cassette and the same cassette at a standstill in the second operation station, said arm being articulated to the machine frame with possibility to rotate alternatively
85 around a parallel axis in the movement direction of the device conveying the radiography cassette, to move from the position in which it stretches out above said cassette to that in which it is in a practically vertical position and then once again in
90 the initial position; at least one rod which supports a double series of parallel elements coupling the opening pin of the cover of said cassette, arranged consecutively, and interspaced in relation to the format of the radiography
95 cassettes foreseen for insertion in the machine, said rod being supported by said arm so that it slides alternatively, longitudinally to it, also being subject to the action of elastic means which keep it pushed against the sliding surfaces of a curved
100 slide arranged to correspond to the rear end of said arm and primed to the machine frame, with the possibility of rotating alternatively around a parallel axis to the rotation axis of said arm.

11. Automatic machine according to claim 7,
105 characterized by the fact that said curved slide is mobile, from a position where its curve centre is eccentric with respect to the rotation axis of the arm to which the rod is associated, which supports said coupling elements, to a position
110 where its curve centre coincides with the rotation axis of said arm, in said position causing said axis, and therefore the coupling devices, to slide forward with respect to said arm, until the coupling device, located in a position to move the
115 trigger opening the cover of the radiography cassette in the machine, is brought to a position where it engages said trigger and opens said cassette, said curved slide remaining at a standstill in said position during the alternate
120 rotation phase of said arm, respectively corresponding to the lifting and lowering of the cover closing the cassette.

12. Automatic machine according to the previous claims where said pusher, which makes
125 the cassette foul a striker element, to which the devices detecting the cassette format are associated, is arranged alongside said device conveying the radiography cassette on the opposite side from the one in which the device
130 opening the same cassette operates,

characterized by the fact that said pusher is
equipped with at least one probe located inside it
and arranged for insertion below the cover closing
the cassette in the initial opening phase, to detach
5 from said cover the film contained in the cassette,

accidentally adhering to same.

13. Automatic machine to load and unload
films in radiography substantially as herein
described with reference to and as illustrated in
10 the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1981. Published by the Patent Office,
25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

A 013683